



US 5,995,221A

**United States Patent** [19][11] **Patent Number:** **5,995,221****Slutter et al.**[45] **Date of Patent:** **Nov. 30, 1999**[54] **MODIFIED CONCENTRIC SPECTROGRAPH**4,618,260 10/1986 Okube .  
5,066,127 11/1991 Schwenker .[75] **Inventors:** **Warren S. Slutter**, Lebanon; **Wu Jiang**, South Plainfield, both of N.J.;  
**Alain F. R. Thevenon**, Bretigny sur Orge; **Viviane D. Millet**, Linas, both of France; **Jeremy J. Goldstone**, Piscataway, N.J.**FOREIGN PATENT DOCUMENTS**2653879 3/1991 France  
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62-49308 3/1987 Japan**OTHER PUBLICATIONS**[73] **Assignee:** **Instruments S.A., Inc.**, Edison, N.J.J. Thomas Brownrigg, "Design and performance of a miniature dual-beam diode-array spectrometer," *Spectroscopy*, vol. 10, Iss. 9 (Nov.-Dec., 1995), pp. 39-44.[21] **Appl. No.:** **08/884,417**

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[22] **Filed:** **Jun. 27, 1997****Related U.S. Application Data**[60] **Provisional application No** 60/039,207, Feb 28, 1997**Primary Examiner**—K. P. Hantis[51] **Int. Cl.<sup>6</sup>** ..... **G01J 3/28****Attorney, Agent, or Firm**—Fish & Neave; Jeffrey H. Ingberman; Brett G. Alten[52] **U.S. Cl.** ..... **356/326**[58] **Field of Search** ..... 356/326, 328,  
356/330-334; 385/37**[57] ABSTRACT****[56] References Cited****U.S. PATENT DOCUMENTS**2,594,334 4/1952 Miller .  
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A modified concentric spectrograph for diffracting light with high stray light rejection without astigmatism is provided. The modified spectrograph includes a grating, a lens, and at least one entrance port and one exit port. The grating has a concave surface and a meridian plane with a first side and a second side. The lens has a substantially planar surface and a convex surface. Preferably, the convex and concave surfaces are substantially concentric. The ports are substantially located on different sides of the meridian plane near a focal plane of the spectrograph. The position of a focal plane may be modified using an optically transmissive triangular prism with a reflective surface, and an optically transmissive block. The position of a focal plane may further be modified with one or more optically transmissive plates. Methods for using the spectrograph are also provided.

**83 Claims, 7 Drawing Sheets**